IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	SU-CHEN FAN et al.	))	
Filed:	Herewith	))	
For:	PRE-TREATMENT FOR SALICIDE PROCESS	)))	

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Dear Sir:

Prior to the examination on merits, please amend the above-identified application as follows:

IN THE SPECIFICATION:

Please replace the paragraph beginning at page 1, line 4 with the following rewritten paragraph:

--This application is a continuation application of, and claims the priority benefit of, U.S. application serial No. 09/777,583 filed on February 6, 2001, which in turn is a continuation application of U.S. application serial No. 09/417,357 filed on October 13, 1999.--

Please replace the paragraph beginning at page 5, line 19 with the following rewritten paragraph:

--Fig. 4 shows the design of the pre-processing chamber. The pre-processing chamber comprises a target 306, first and second RF power supplies 302, 304 for ionizing sputtered metal atoms, and a heater 310 (or E-chuck) for providing the substrate bias. The ionization energy of titanium and argon are 6.8 eV and 15.8 eV, respectively. By proper modification of the RF power, substrate position (such as on the IMP target or on the heater), and substrate bias, argon ions can be manipulated, without argon deposition, to simultaneously dry clean and amorphize the exposed substrate 300 and polysilicon gate. Note that argon (AMU 40) is heavier than silicon (AMU 28), and is therefore more efficient in the amorphization of the exposed substrate 300 and

polysilicon gate.--

Please replace the paragraph beginning at page 6, line 5 with the following rewritten paragraph:

--Specifically, when the dry surface treatment is implemented, two power supplies 302, 304 are separately provided to the argon and the heater 310 (also substrate electrode). The power provided to the substrate electrode 310 causes the substrate 300 to acquire a self-bias, and thereby accelerates argon ions from the target 310 toward the exposed substrate 300 and polysilicon gate. Thus, the exposed substrate 300 and polysilicon gate are subject to some bombardment by the argon ions 308 from the target 310. The argon is preferably provided with a bias of about 250W to about 450W from the first power supply 302, while the substrate 300 is preferably provided with a bias of about 150W to about 300W. 450W is an upper limit provided to a conventional IMP chamber, but the upper limit is variable according to the development of plasma equipment. By properly modifying the quantities of the RF power, the substrate bias and the substrate position (preferably on the heater), this dry surface treatment can be harnessed to simultaneously amorphize and clean the exposed substrate 300 and polysilicon gate.--

Please replace the paragraph beginning at page 6, line 18 with the following rewritten paragraph:

--In the description of the related art, the biases provided to the argon and to the substrate 300 are conventionally about 50-300W and 100-150W, respectively. Because the biases are provided only for dry cleaning, rather than for amorphization, they are substantially lower than the biases provided for dry cleaning as well as amorphization in the present invention. In other words, if the biases provided are substantially higher than the biases provided for only dry cleaning in the prior art, they are sufficient to dry clean as well as amorphize the exposed

substrate 300 and polysilicon gate. That is, the biases assembly provided in the present invention is not limited to about 250-450W or about 150-300W. Any bias assembly which achieves cleaning as well as the amorphization function is within the scope of the invention. The degree of the amorphization can be adjusted with different degrees of argon ionization or with different substrate biases.--

IN THE CLAIMS:

Please cancel claims 3 and 8 without prejudice and disclaimer.

Please amend claims 1,4-7, and 9-12 as follows:

1. (Amended) A method for treating a silicon substrate, comprising:

placing the silicon substrate into a sputtering chamber;

performing a sputtering step to simultaneously dry clean and amorphize the silicon substrate surface by first using the sputtering chamber; and

depositing a titanium film on the amorphized silicon substrate by second using the same sputtering chamber, wherein the sputtering chamber is an ionized metal plasma (IMP) equipment unit.

4. (Amended) A method for treating a silicon substrate having a surface, comprising:

providing a pre-processing chamber, wherein the pre-processing chamber has first and second power supplies for sputtering argon therein, wherein the first power supply can provide the argon with a first bias, and the second power supply can provide the silicon substrate with a second bias;

placing the silicon substrate into the pre-processing chamber;

providing the first bias to the argon;

providing the second bias to the silicon substrate;

modifying the first bias and the second bias to sputter the argon to simultaneously dry clean and amorphize the substrate surface;

forming a metal film on the amorphized substrate surface;

performing an annealing step, so that the metal film is reacted with the substrate surface to form a metal silicide layer; and

removing the metal film which is not reacted with the substrate surface.

5. (Amended) The method of claim 4, wherein the first bias is substantially higher than the second bias.

6. (Amended) The method of claim 4, wherein dry cleaning and amorphizing the substrate surface and forming the metal film are performed in different chambers.

7. (Amended) The method of claim 4, wherein dry cleaning and amorphizing the substrate surface and forming the metal film are performed within the same chamber.

9. (Amended) The method of claim 4, wherein the metal film is deposited in the pre-processing chamber.

10. (Amended) The method of claim 4, wherein the metal film is made of titanium (Ti).

11. (Amended) The method of claim 4, wherein the metal film is made of cobalt (Co).

12. The method of claim 4, wherein the metal film is deposited by $TiCl_4$-based CVD.

Please add new claim 13:

13. (New) The method of claim 4, wherein the metal film is formed on the amorphized substrate surface at a temperature of about 540°C.

Respectfully submitted,

Dated: 2/ 11/2002

By: ____________________
Jiawei Huang
Registration No. 43,330

J.C. Patents
4 Venture, Suite 250
Irvine, CA 92618
(949) 660-0761

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The paragraph beginning at page 1, line 4 has been amended as follows:

--This application is a continuation application of, and claims the priority benefit of [Taiwan application serial no. 88115321, filed Sep. 6, 1999], U.S. application serial No. 09/77,583 filed on February 6, 2001, which in turn is a continuation application of U.S. application serial No. 09/417,357 filed on October 13, 1999.--

The paragraph beginning at page 5, line 19 has been amended as follows:

--Fig. 4 shows the design of the pre-processing chamber. The pre-processing chamber comprises a target 306, first and second RF power supplies 302, 304 for ionizing sputtered metal atoms, and a heater 310 (or E-chuck) for providing the substrate bias. The ionization energy of titanium and argon are 6.8 eV and 15.8 eV, respectively. By proper modification of the RF power, substrate position (such as on the IMP target or on the heater), and substrate bias, argon ions can be manipulated, without argon deposition, to simultaneously dry clean and amorphize the exposed substrate [200] 300 and polysilicon gate [204]. Note that argon (AMU 40) is heavier than silicon (AMU 28), and is therefore more efficient in the amorphization of the exposed substrate [200] 300 and polysilicon gate [204].--

The paragraph beginning at page 6, line 5 has been amended as follows:

--Specifically, when the dry surface treatment is implemented, two power supplies 302, 304 are separately provided to the argon and the heater 310 (also substrate electrode). The power provided to the substrate electrode 310 causes the substrate [200] 300 to acquire a self-bias, and

thereby accelerates argon ions from the target 310 toward the exposed substrate [200] 300 and polysilicon gate [204]. Thus, the exposed substrate [200] 300 and polysilicon gate [204] are subject to some bombardment by the argon ions 308 from the target 310. The argon is preferably provided with a bias of about 250W to about 450W from the first power supply 302, while the substrate [200] 300 is preferably provided with a bias of about 150W to about 300W. 450W is an upper limit provided to a conventional IMP chamber, but the upper limit is variable according to the development of plasma equipment. By properly modifying the quantities of the RF power, the substrate bias and the substrate position (preferably on the heater), this dry surface treatment can be harnessed to simultaneously amorphize and clean the exposed substrate [200] 300 and polysilicon gate [204].--

The paragraph beginning at page 6, line 18 has been changed as follows:

--In the description of the related art, the biases provided to the argon and to the substrate [200] 300 are conventionally about 50-300W and 100-150W, respectively. Because the biases are provided only for dry cleaning, rather than for amorphization, they are substantially lower than the biases provided for dry cleaning as well as amorphization in the present invention. In other words, if the biases provided are substantially higher than the biases provided for only dry cleaning in the prior art, they are sufficient to dry clean as well as amorphize the exposed substrate [200] 300 and polysilicon gate [204]. That is, the biases assembly provided in the present invention is not limited to about 250-450W or about 150-300W. Any bias assembly which achieves cleaning as well as the amorphization function is within the scope of the invention. The degree of the amorphization can be adjusted with different degrees of argon ionization or with different substrate biases.--

IN THE CLAIMS:

Claims 3 and 8 have been canceled without disclaimer and prejudice.

Claims 1, 4-7, and 9-12 have been amended as follows:

1. (Amended) A method for treating a silicon substrate, comprising:

placing the silicon substrate into a sputtering [equipment unit] chamber;

performing a sputtering step to simultaneously dry clean and amorphize the silicon substrate surface by first using the sputtering [equipment unit] chamber; and

depositing a titanium film on the amorphized silicon substrate by second using the same sputtering chamber, wherein the sputtering chamber is an ionized metal plasma (IMP) equipment unit.

4. (Amended) A method for treating a silicon substrate having a surface, comprising:

providing a pre-processing chamber, wherein the pre-processing chamber has first and second power supplies for sputtering argon therein, wherein the first power supply can provide the argon with a first bias, and the second power supply can provide the silicon substrate with a second bias;

placing the silicon substrate into the pre-processing chamber;

providing the first bias to the argon;

providing the second bias to the silicon substrate; [and]

modifying the first bias and the second bias to sputter the argon to simultaneously dry clean and amorphize the substrate surface;

forming a metal film on the amorphized substrate surface;

performing an annealing step, so that the metal film is reacted with the substrate surface to form a metal silicide layer; and

removing the metal film which is not reacted with the substrate surface.

5. (Amended) The method of claim 4, wherein the first bias is [about 250W to about 450W] substantially higher than the second bias.

6. (Amended) The method of claim 4, wherein [the second bias is about 150W to about 300W] dry cleaning and amorphizing the substrate surface and forming the metal film are performed in different chambers.

7. (Amended) The method of claim 4, wherein [the pre-processing chamber is a chamber in an ionized metal plasma (IMP) equipment unit] dry cleaning and amorphizing the substrate surface and forming the metal film are performed within the same chamber.

9. (Amended) The method of claim [8] 4, wherein the metal film is deposited in the pre-processing chamber.

10. (Amended) The method of claim [8] 4, wherein the metal film is made of titanium (Ti).

11. (Amended) The method of claim [8] 4, wherein the metal film is made of cobalt (Co).

12. The method of claim [10] 4, wherein the metal film is deposited by $TiCl_4$-based CVD.

New claim 13 has been added.